



Geothermal Resources of California: Moving from Assessments towards Development

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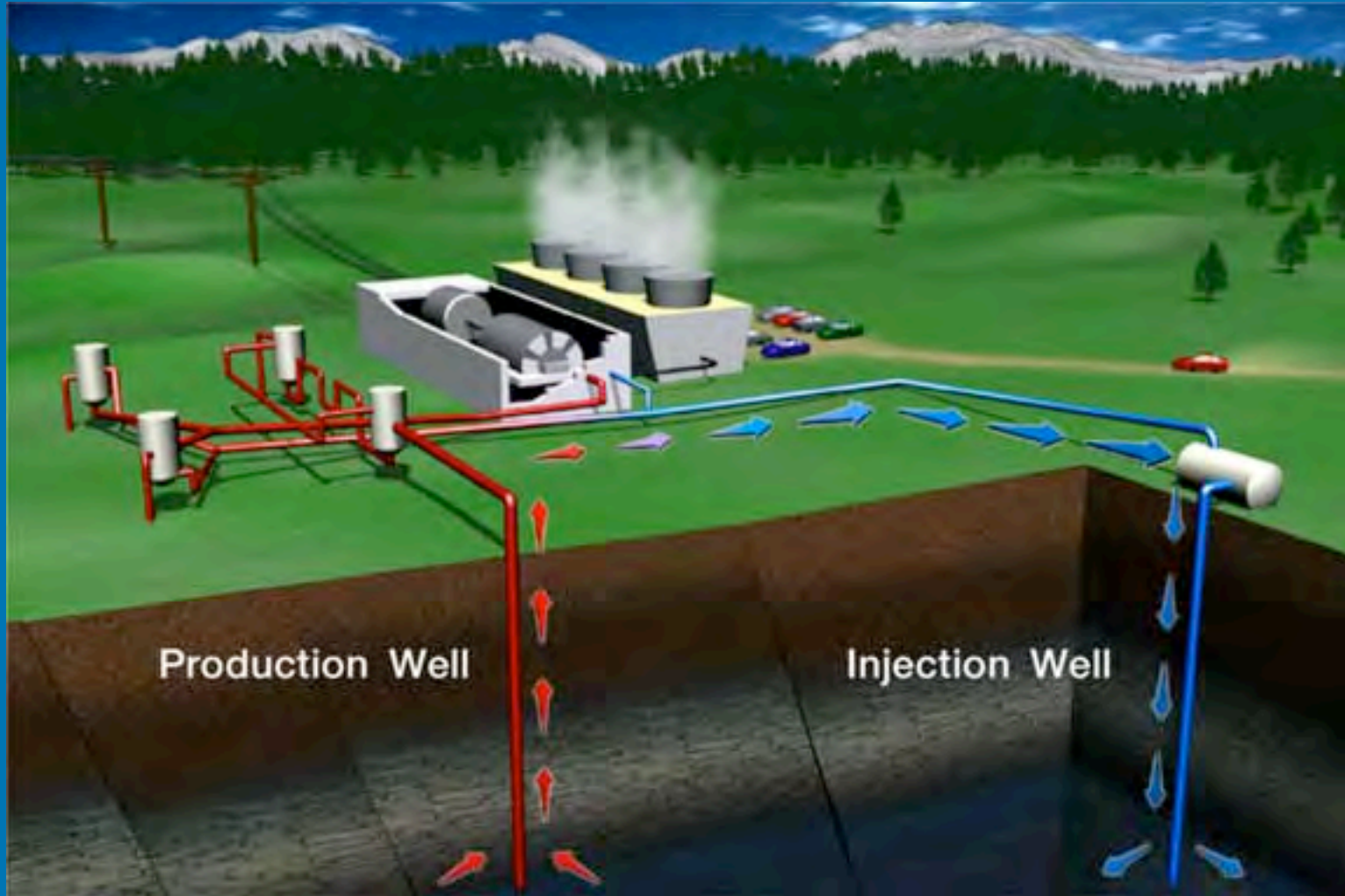
USGS, Menlo Park, CA

U.S. Department of the Interior
U.S. Geological Survey

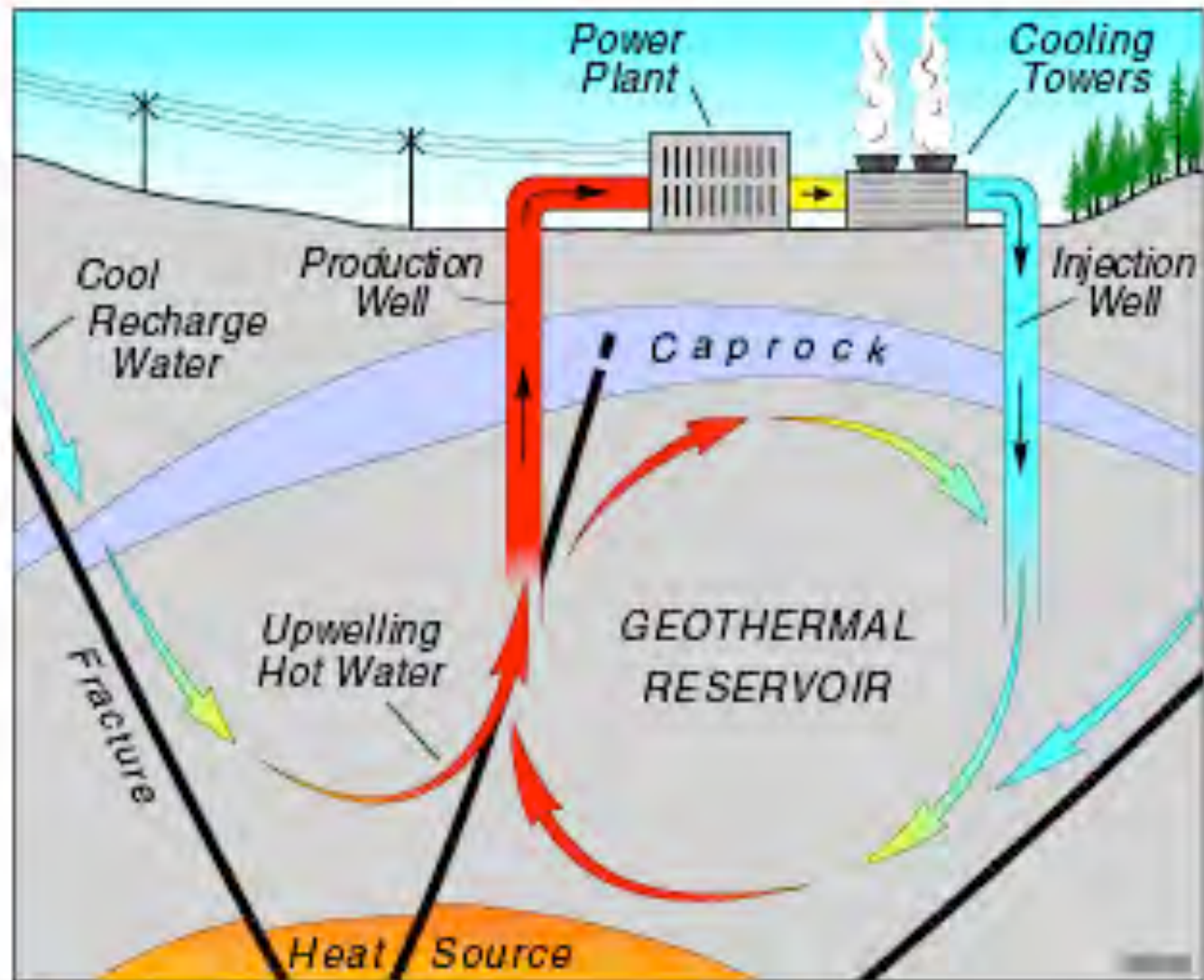
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- **Sean Hagerty, Bureau of Land Management**
- **Jim Lovekin, GeothermEx**
- **Marshall Reed, US Geological Survey**

Idealized Geothermal Power Plant



Need: Heat (Temperature) and Fluid (Permeability)



GEA 1999

Some Terminology

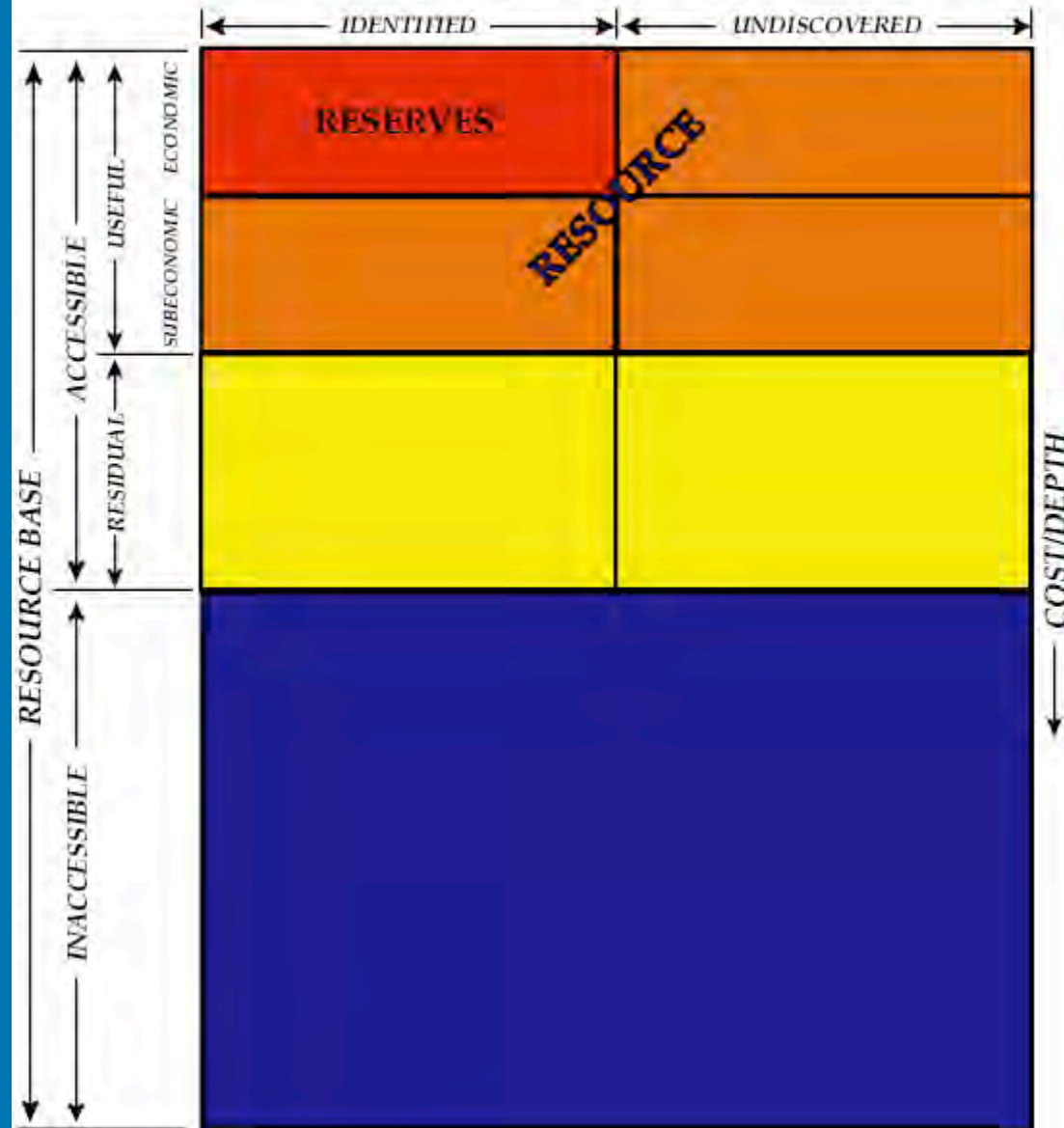
Geothermal Resources are characterized by the degree of knowledge (e.g., discovered vs. undiscovered) and economic/technological feasibility.

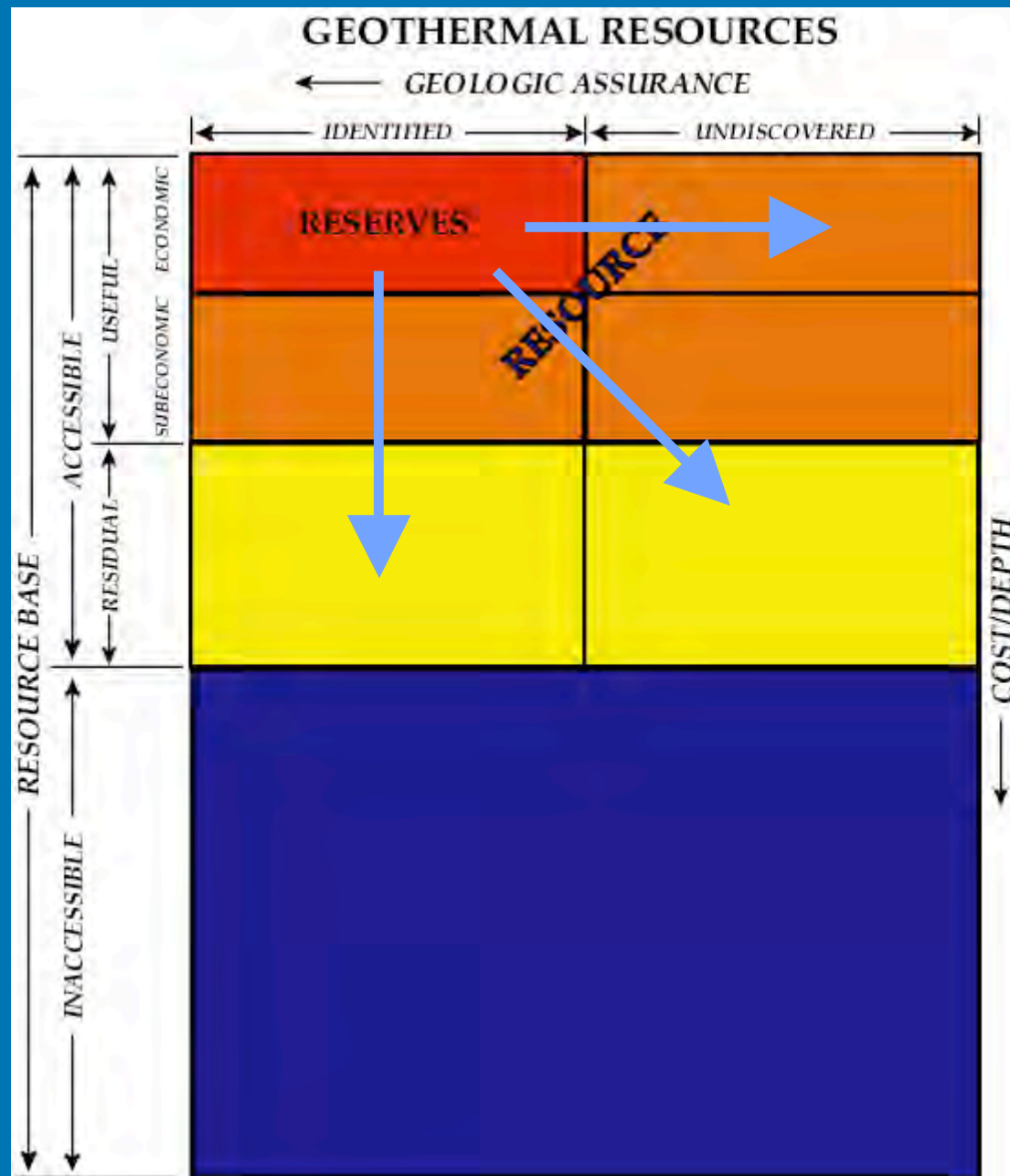
Resource – The portion of the resource base that can be recovered as useful heat under current and potential economic and technological conditions.

Reserve - The identified portion of the resource that can be recovered economically using existing technology.

GEO THERMAL RESOURCES

← GEOLOGIC ASSURANCE













Status of California Geothermal

- At one point approximately 2800 MWe installed
- Currently >2000 MWe
- 1978 USGS Resource Assessment
 - 12,000 MWe in identified systems
 - >10,000 MWe in undiscovered systems
- 2004 Resource Assessment - Geothermex
 - >5000 MWe in identified, conventional resources
- Largest resource in U.S., both installed and in potential development

Developments in Geothermal

-  Temperature $>200^{\circ}\text{F}$ (95°C) and Depth $>10,000\text{ft}$ (3 km) for power production
-  New systems discovered
-  Improved techniques for characterizing reservoirs
-  Increasing use of injection to sustain production
-  Development of Enhanced Geothermal Systems (EGS) technology
-  Potential for more accurate estimates of undiscovered resources

Future Directions

- **Comprehensive Resource Assessments**
 - Combine National, State and Local Information in a Single Coherent Product
- **Confirmation of Resource**
- **Refined Land Use Plans**
- **Exploration**
- **Continuing Development of EGS Technology**
- **New and Unconventional Applications**
 - Hydrogen
 - Local Use in Urban Areas

**Geothermal Power Development in Western States with
Estimated Resources Greater than 100 MW - Electrical**

